Space Weather Technical Forecast

Issued on Friday 21 March 2025 at 13:07 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Chance G1-G2/Minor-Moderate Storms throughout, due to CME arrivals, and a HSS connection.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with only C-class flares. There are currently 12 sunspots on the Earth facing disc, consisting of eight numbered regions and four unnumbered regions. Despite the large amount of sunspots, the vast majority are small and simple and have remained largely unchanged in recent hours. The largest, AR4031, has shown some recent development of its intermediate spots.

A filament eruption occurred around 20/1823 UTC, from the southeast quadrant, close to centre disc, but no associated CME was observed in available imagery. If a CME was emitted it could potentially have an Earth directed component.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR at L1, were between background and slightly elevated levels, seeing a sharp rise to around 440km/s following the CME arrival at 21/0141UTC, then slowly declining to current background levels around 380 km/s. Density was initially average, but following the CME arrival it became above average, peaking at 25ppcc at 21/0414UTC. Interplanetary Magnetic Field, Bt, was weak, 8nT or less, for much of the period, but became moderate from around 21/1000UTC. The north-south component, Bz, being weak ranging between -5 and +8nT, favouring negative until around 21/0500UTC after which point it favoured a positive direction. Phi angle was negative (towards the sun) until 21/0420UTC, at which point it rotated positive (away from the sun). Geomagnetic activity was Quiet to unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was mostly at background to moderate. The 24-hour fluence was below the Active threshold. The observed integrated pfu was 2.28e7 at 21/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Low activity is expected, with a chance of isolated M-class flares.

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Solar Wind / Geomagnetic Activity: Solar winds are expected to generally be at background levels, rising slightly with any weak/glancing CME arrivals, until a connection with a high speed stream associated with CH24/- in the western hemisphere. This high speed stream connection is most likely to occur through later Day 2, or perhaps into Day 3 (22-23 Mar) with solar winds perhaps reaching elevated levels (500+ km/s).

Generally Quiet activity is expected initially, with a chance of G1-G2/Minor-Moderate storms throughout should any of the possible CMEs arrive, combined with the HSS from CH24.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement from any larger flares. High energy electron flux is expected to continue at background levels. Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period.

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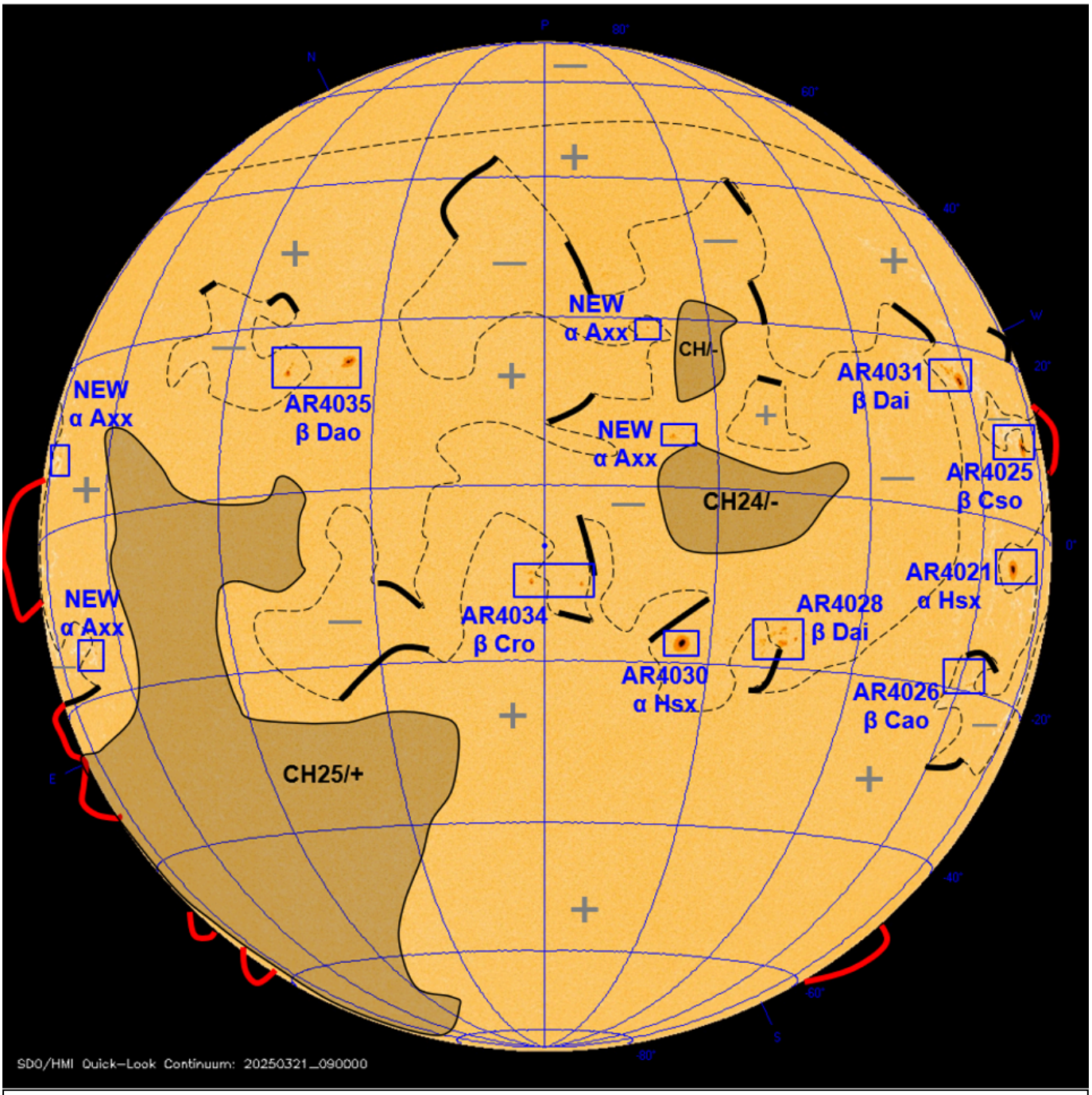
Figure 1: Synoptic Map valid 21/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A weak CME arrived overnight, reaching L1 at 21/0141UTC which was likely in association with a filament eruption to the northeast of the disc early on the 18th of March. A CME which was observed leaving the Suns NE limb early on 19 Mar, possibly as a result of a filament eruption from the north-centre disc that occurred around 19/0034 UTC. This has been analysed and results in ENLIL suggest a potential glancing blow at Earth late on Day 2 (22 Mar). Over the past few days there has been evidence of some weak eruptions from near centre disc, most notably a filament eruption around 20/1800UTC. However there was no clear CME in coronagraph imagery so this has been omitted from the forecast, however it does not rule out the possibility of a weak transient CME over the next few days and hence confidence in the CME forecast is lower than usual.

Solar winds are expected to generally be at background levels, rising slightly with any weak/glancing CME arrivals, until a connection with a high speed stream associated with CH24/- in the western hemisphere. This high speed stream connection is most likely to occur through later Day 2, or perhaps into Day 3 (22-23 Mar) with solar winds perhaps reaching elevated levels (500+ km/s).

Generally Quiet activity is expected initially, with a chance of G1-G2/Minor-Moderate storms throughout should any of the possible CMEs arrive, combined with the HSS from CH24.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	50	50	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
19/1121	Partial	Filament Eruption	North-centre	635	22/1900	Glancing blow from shock possible.

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Figure 2: Latest MOSWOC Enlil.

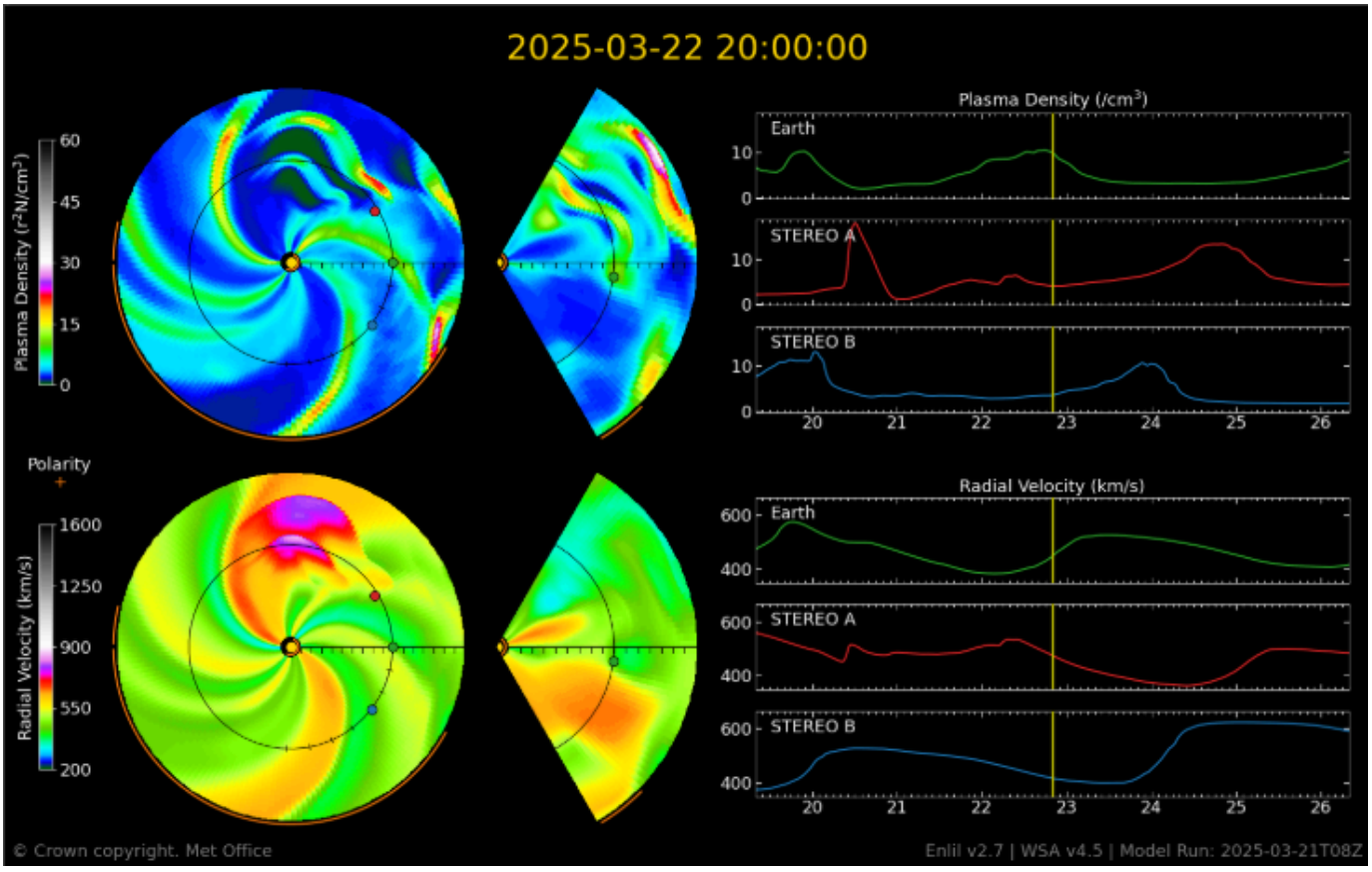

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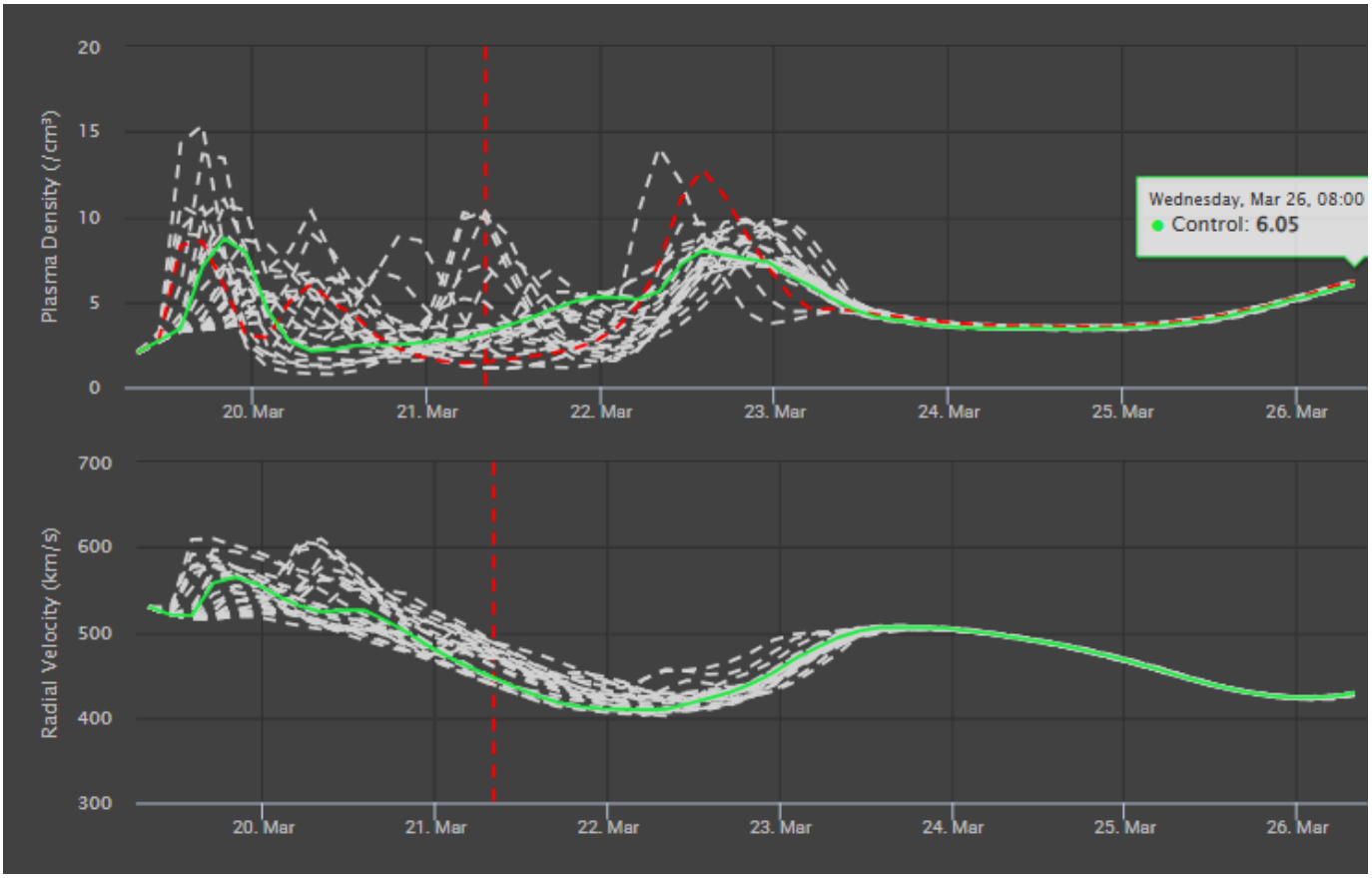
Figure 3: Latest MOSWOC Enlil ensemble.



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Radio Blackouts - X-Ray Flares

Solar activity has been Low, with only C-class flares observed.

There are currently 12 sunspots on the Earth facing disc, consisting of eight numbered regions and four unnumbered regions. Despite the large amount of sunspots, the vast majority are small and simple and have remained largely unchanged in recent hours. The largest, AR4031, has shown some recent development of its intermediate spots.

Generally Low activity is expected, with a chance of isolated M-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	30	30	30	30
Very Active	R3-R5 (X Class)	No	1	1	1	1

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current inactivity and magnetic simplicity of the small regions on the Earth-facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux was at background to moderate levels. With possible weak CME arrivals over the next few days, most likely late on the Day 2 (22 Mar), flux levels are expected to remain at background until later in the period after the arrival of the HSS from CH24.

MOSWOC REFM shows the electron fluence should remain below the Active threshold throughout the remainder of the period, and is considered reasonable guidance, albeit with low confidence as a slightly increasing trend towards the end of the period is preferred.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	5	5	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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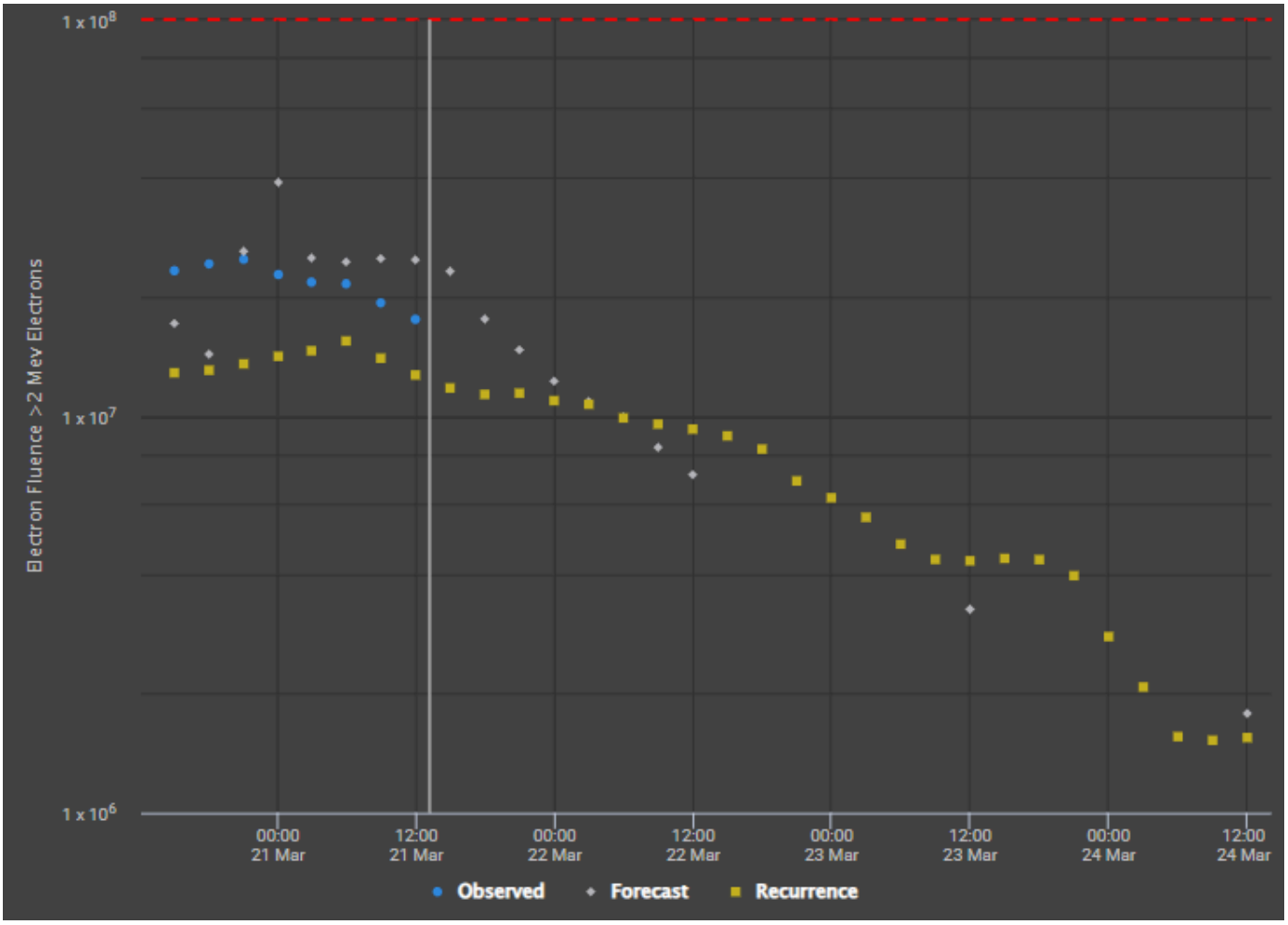
Figure 4: MOSWOC REFM model.



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